

Orientation for the week

**”Water and Environmental
Quality”**

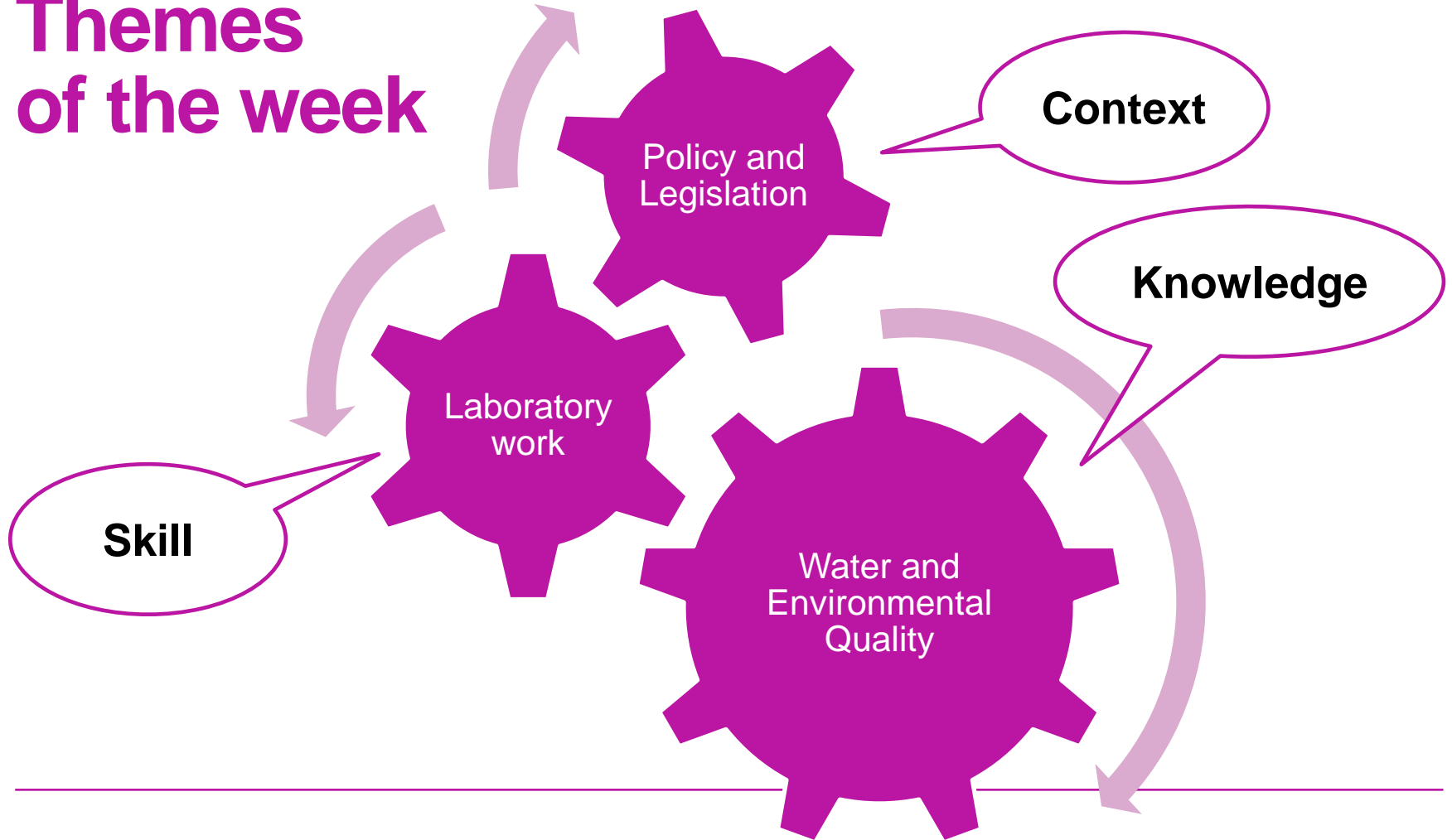
Prof. Riku Vahala

Learning objectives of the week

After the completion of the week the student is able to...

- Identify the broader societal context relevant to water and environmental engineering, including the key governance (**policy and legislation**) and entrepreneurial aspects [*knowledge*]
- Understand the key principles of **good environmental and water quality** [*knowledge*]
- Can apply basic water and **environmental measurement methods and related basic analyses in the laboratory** and in the flume [*skill*]

Themes of the week



Knowledge

Water and Environmental Quality

Kielo Isomäki

Material to be used in the essay

Lectures & lecture material

Reading material in My Courses (you need to be in Aalto's network in order to access the e-books):

- Day, J. & Dallas, H.: Understanding the basics of water quality. In Grafton, R.Q. & Hussey, K.: Water resources planning and management, Cambridge University Press 2011 (Chapter 4, pp. 68-89).
- Sullivan, C.A. & O'Keeffe, J.: Water, biodiversity and ecosystems: reducing our impact. In Grafton, R.Q. & Hussey, K.: Water resources planning and management, Cambridge University Press 2011 (Chapter 6, pp. 117-130).
- Almasri, M.N. & Kaluarachchi, J.J.: Groundwater quality: Fate and transport of contaminants (NOTE: read only pages 36-44). In Aral, M.M & Taylor, S.W.: Groundwater quality and quantity management, American Society of Civil Engineers 2011 (Chapter 3, pp. 36-44).

(You can refer to lab exercises on Tue-Thu if you wish, but this is not obligatory)

→ Essay assignment supports you to gather the essential knowledge and to reflect on that with your future profession as an engineer → achieving the week's learning outcomes

Essay = Home exam

Write an essay on the following subject:

Contributing to a good environmental and water quality as a WAT engineer

- The essay should be based on the lectures and lecture material on Monday, and on the given three book chapters (remember to refer to your sources adequately!).
- The essay ought to be max four pages (excluding list of references) with 25mm marginal, 12pt font and a line spacing of 1.5.
- Submit the essay (as .doc or .pdf) through Turnitin-submission box in MyCourses.

Your essay could answer e.g. to the following questions:

- How to define a good environmental and water quality?
- What affects good environmental and water quality?
- What kind of consequences contamination may cause?
- What are the key institutional, legal and economic aspects that relate to managing environmental and water quality?
- Identification of different disciplines that are connected to managing good environmental and water quality;
- Reflection to own professional performance and future requirements that relate to contributing to environmental and water quality management.

Grading of the Essay is based on the following rubrics :

1. = Able to identify and list a very limited number of points. No evidence of using these points to provide reasoning to why and how they are interrelated. Very limited use of given reference material. The essay as a whole reflects a very limited level of understanding of the learning outcomes for the week.
 2. = Able to identify and briefly write about limited points. Very little evidence of using these points to provide reasoning to why and how they are interrelated. Very little or no evidence on causalities or consequences. Very limited use of given reference material. The essay as a whole reflects a limited level of understanding of the learning outcomes for the week.
 3. = Able to identify a number of relevant points with some details. Using these points to provide a fair reasoning or causality. No evidence of a comprehensive overview of reasoning, interrelations, causalities or consequences. Limited use of given reference material. The essay as a whole reflects a good level of understanding of the learning outcomes for the week.
 4. = Able to identify a full range of relevant points with details, supported by good use of given reference material. Points are organized to provide a comprehensive and cohesive reasoning or causality. Able to give an example of an own professional requirement related to current reasoning. The essay as a whole reflects a good level of mastering the learning outcomes for the week.
 5. = Able to identify a full range of relevant points with details, supported by good use of given reference material. Points are organized to provide a comprehensive and cohesive reasoning or evidence on causalities and consequences. Able to link current reasoning to own professional performance and future requirements. The essay as a whole reflects an excellent level of mastering the learning outcomes for the week.
-

Skill

Laboratory Work

Laboratory report

Each group has been signed with one mystery water sample. Through a series of different quality analyses, each group is supposed to discover which sample they are working with. The analyses conducted are presented in the Laboratory Analyses –printout (see MyCourses). Please familiarize yourselves with the analysis prior to the session, this will significantly facilitate and speed up the session for everyone. If you come unprepared, it is very easy to forget everything you have done quickly.

More information on the laboratory report, the content and instructions will be given during the laboratory exercise and on Tuesday morning.

Laboratory safety exam

NOTE! In order to be able to participate in the laboratory analysis, you have to have passed the Laboratory Safety Exam.

Any feedback about the exam?

Context

Policy and Legislation

Context

In your laboratory report, try to assess, whether your water is suitable for bathing according to the European Bathing Water Directive? Is it safe to drink according to Drinking Water Directive? Is the water body achieving “good status” according to the Water Framework Directive? If not, why?

Timetable

Monday

09.00: Orientation for Water & Environmental Week, Riku Vahala

10.30: One example of environmental pollution:

- Emerging micropollutants in wastewater treatment, Dr. Antonina Kruglova

Afternoon individual reading for the home exam.

Tuesday

09:00-9:30 Introduction of the laboratory work (Group 6 in water building)

10:00 - 12:30 Group 6

13:30 - 16:00 Group 5

Wednesday

08:30 - 11:00 Group 4

12:00 - 14:30 Group 3

Thursday

08:30 - 11:00 Group 2

12:00 - 14:30 Group 1

Friday

13.00-16.00 Wrap-up session (Presentation of each group's mystery water. Present the results and the basis for your conclusions. 10 minutes each group.)

What kind of waters can you identify?

For example: Drinking water

What characteristics do you consider important in them?

One does not get sick and,...

Which quality parameters describe the important characteristics in water

For example:

Indicators such as E.coli and enterococci are used to assess the absence of pathogens in drinking water.

How would you control that the quality is maintained over the time?

For example:

- In EU, drinking water directive sets the sampling frequency of tap water for E.coli and enterococci

...

Example: Parameters in drinking water directive (2020/2184)

Part A: Microbiological parameters

- Enterococci and *E.coli*

Part B: Chemical parameters (34)

- Acrylamid, antimony, arsenic,..

Part C: Indicator parameters (18)

- Aluminium, ammonium, chloride,...

Part D: Parameters relevant for the risk assessment of domestic distribution systems

- *Legionella*, Lead

On 16 December 2020, the European Parliament formally adopted the revised Drinking Water Directive. The Directive entered in force on 12 January 2021, and Member States have two years to transpose it into national legislation.

Some relevant European directives

Bathing Water Directive:

- Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC

Drinking Water Directive:

- Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption

Water Framework Directive:

- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

Bathing Water Directive

CHAPTER I GENERAL PROVISIONS

Article 1

Purpose and scope

1. This Directive lays down provisions for:
 - (a) the monitoring and classification of bathing water quality;
 - (b) the management of bathing water quality; and
 - (c) the provision of information to the public on bathing water quality.
2. The purpose of this Directive is to preserve, protect and improve the quality of the environment and to protect human health by complementing Directive 2000/60/EC.

Bathing Water Directive

CHAPTER II QUALITY AND MANAGEMENT OF BATHING WATER

Article 3

Monitoring

1. Member States shall annually identify all bathing waters and define the length of the bathing season. They shall do so for the first time before the start of the first bathing season after 24 March 2008.
2. Member States shall ensure that monitoring of the parameters set out in Annex I, column A, takes place in accordance with Annex IV.
3. The monitoring point shall be the location within the bathing water where:
 - (a) most bathers are expected; or
 - (b) the greatest risk of pollution is expected, according to the bathing water profile.

ANNEX I

For inland waters

	A	B	C	D	E
	Parameter	Excellent quality	Good quality	Sufficient	Reference methods of analysis
1	Intestinal enterococci (cfu/100 ml)	200 (1)	400 (1)	330 (2)	ISO 7899-1 or ISO 7899-2
2	Escherichia coli (cfu/100 ml)	500 (1)	1 000 (1)	900 (2)	ISO 9308-3 or ISO 9308-1

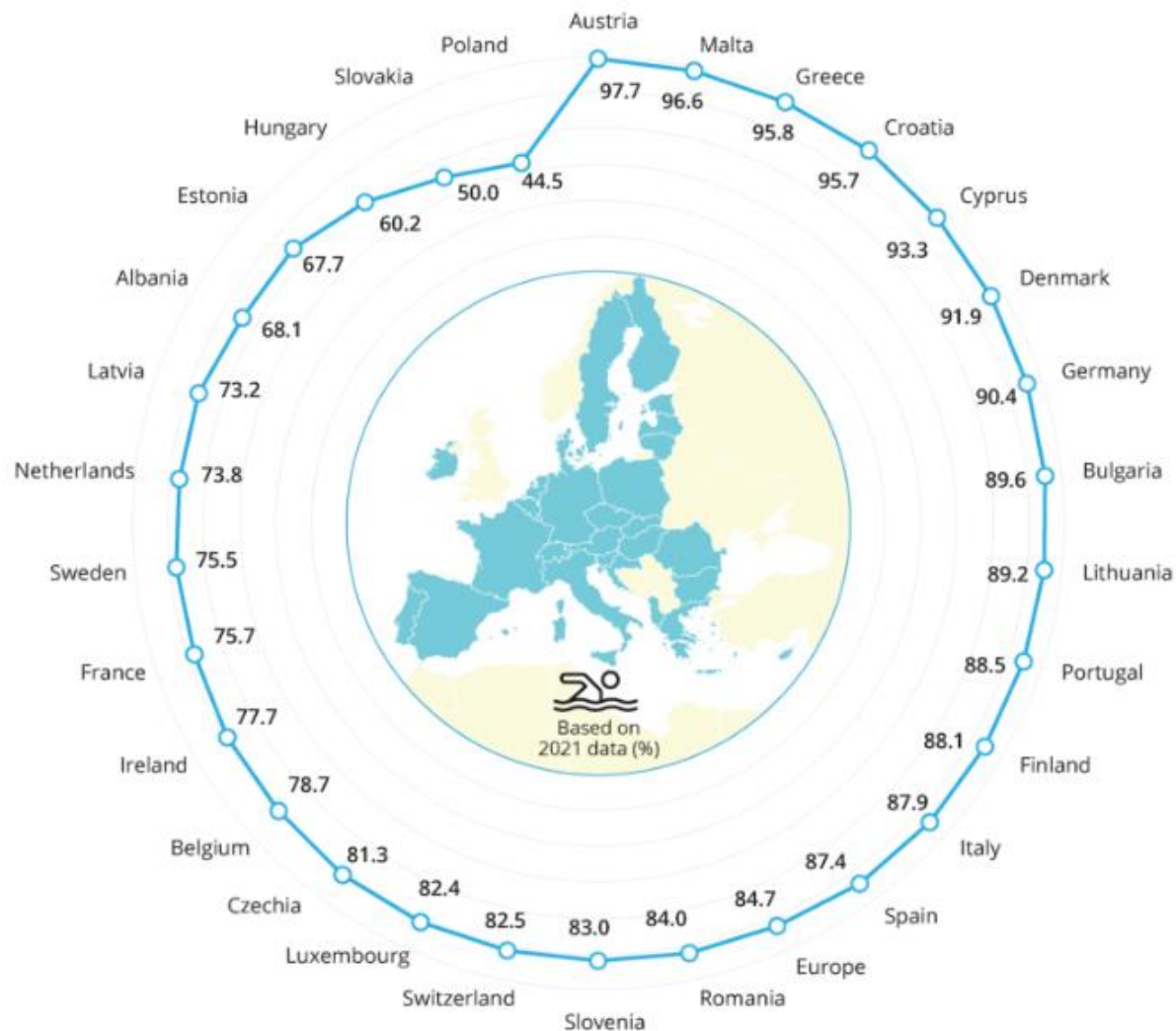
For coastal waters and transitional waters

	A	B	C	D	E
	Parameter	Excellent quality	Good quality	Sufficient	Reference methods of analysis
1	Intestinal enterococci (cfu/100 ml)	100 (3)	200 (3)	185 (4)	ISO 7899-1 or ISO 7899-2
2	Escherichia coli (cfu/100 ml)	250 (3)	500 (3)	500 (4)	ISO 9308-3 or ISO 9308-1

Bathing water

Source: European bathing
water quality in 2021 —
European Environment
Agency (europa.eu)

Figure 1: Proportion of bathing waters with excellent quality in European countries in 2021



Drinking Water Directive

Article 1

Objectives

1. This Directive concerns the quality of water intended for human consumption for all in the Union.
2. The objectives of this Directive are to protect human health from the adverse effects of any contamination of water intended for human consumption by ensuring that it is wholesome and clean, and to improve access to water intended for human consumption.

...

Drinking Water Directive

Article 13

Monitoring

1. Member States shall take all measures necessary to ensure that regular monitoring of the quality of water intended for human consumption is carried out in accordance with this Article and Parts A and B of Annex II, in order to check that the water available to consumers meets the requirements of this Directive and in particular the parametric values set in accordance with Article 5. Samples of water intended for human consumption shall be taken so that they are representative of its quality throughout the year.

Drinking Water Directive

Table 1. Minimum frequency of sampling and analysis for compliance monitoring

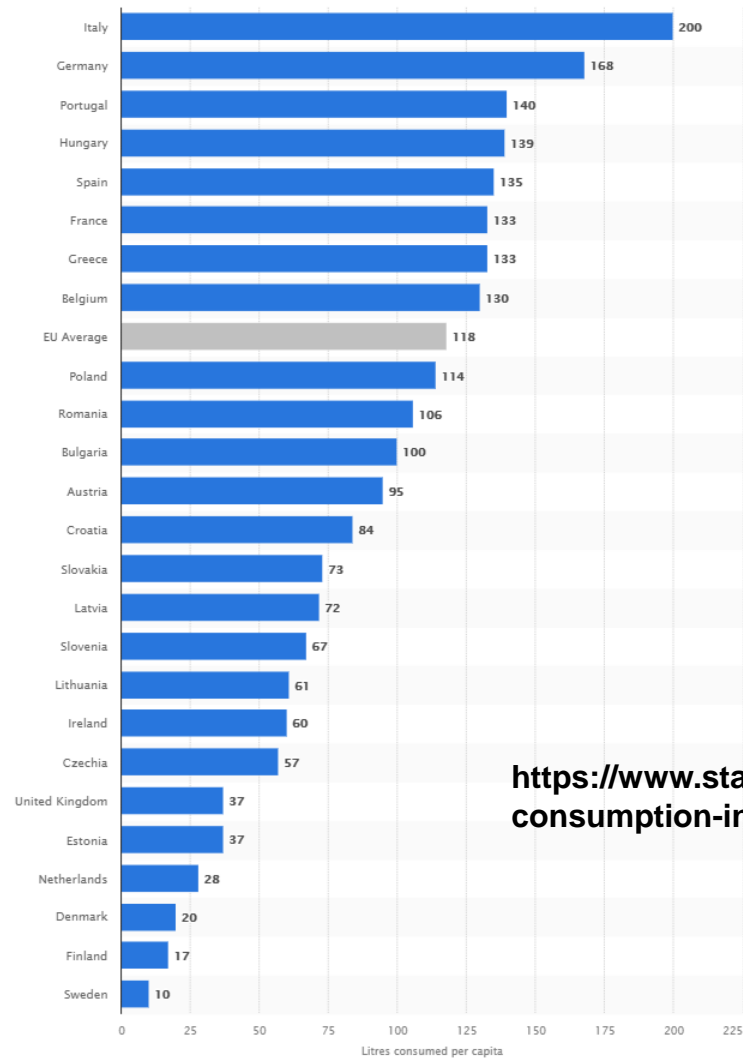
Volume of water distributed or produced each day within a supply zone (See Notes 1 and 2) m ³		Group A parameter number of samples per year	Group B parameter number of samples per year
	< 10	> 0 (See Note 4)	> 0 (See Note 4)
≥ 10	≤ 100	2	1 (See Note 5)
> 100	≤ 1 000	4	1
> 1 000	≤ 10 000	4 for the first 1 000 m ³ /d + 3 for each additional 1 000 m ³ /d and part thereof of the total volume (See Note 3)	1 for the first 1 000 m ³ /d + 1 for each additional 4 500 m ³ /d and part thereof of the total volume (See Note 3)
> 10 000	≤ 100 000		3 for first 10 000 m ³ /d + 1 for each additional 10 000 m ³ /d and part thereof of the total volume (See Note 3)
> 100 000			12 for first 100 000 m ³ /d + 1 for each additional 25 000 m ³ /d and part thereof of the total volume (See Note 3)

Compliance rates at national level in the Member States (2011-2013)

	Microbiological parameters	Chemical parameters	Indicator parameters*				
Austria	99,84	99,9	99,6	Lithuania	100	99,3	99
Belgium	99,75	99,9	99,1	Luxembourg	99,77	100	99,5
Bulgaria	99,25	99,5	99,3	Latvia	99,92	100	98,7
Cyprus	99,01	99,9	96,3	Malta	100	99,9	90,1
Czech R.	99,91	99,9	99,2	the Netherlands	99,97	100	100
Germany	99,88	99,9	99,7	Poland	100	100	99,8
Denmark	99,8	99,8	98,6	Portugal	99,57	99,9	99,3
Estonia	99,99	99,8	99,1	Romania	99,69	99,7	99,2
Spain	99,62	99,8	99,4	Sweden	99,94	100	99,1
Finland	100	99,9	99,6	Slovenia	99,25	100	98,7
France	99,84	99,8	99,4	Slovakia	99,52	100	99,4
Greece	99,64	99,9	99,5	United Kingdom	99,98	99,9	99,9
Hungary	99,71	98,6	97,1	Source: European Commission, Drinking water reporting requirements and synthesis reports. pp. 12-13, Link to report *except odour, taste colour and turbidity			
Ireland	99,97	99,5	99,3				
Italy	99,2	99,6	99,6				

Per capita consumption of bottled water in Europe in 2019, by country

(in liters per capita)



<https://www.statista.com/statistics/455422/bottled-water-consumption-in-europe-per-capita/>

DOWNLOAD



SOURCE

Sources

GlobalData; European Federation of Bottled Water

Survey by

GlobalData

Published by

European Federation of Bottled Water

Source link

efbw.org

Release date

December 2020

Water Framework Directive

Article 1

Purpose

The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which:

- (a) prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;
- (b) promotes sustainable water use based on a long-term protection of available water resources;
- (c) aims at enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances;
- (d) ensures the progressive reduction of pollution of groundwater and prevents its further pollution, and
- (e) contributes to mitigating the effects of floods and droughts

and thereby contributes to:

- the provision of the sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use,
- a significant reduction in pollution of groundwater,
- the protection of territorial and marine waters, and

Article 4

Environmental objectives

1. In making operational the programmes of measures specified in the river basin management plans:

(a) for surface waters

(i) Member States shall implement the necessary measures to prevent deterioration of the status of all bodies of surface water, subject to the application of paragraphs 6 and 7 and without prejudice to paragraph 8;

(ii) Member States shall protect, enhance and restore all bodies of surface water, subject to the application of subparagraph (iii) for artificial and heavily modified bodies of water, with the aim of achieving good surface water status at the latest 15 years after the date of entry into force of this Directive, in accordance with the provisions laid down in Annex V, subject to the application of extensions determined in accordance with paragraph 4 and to the application of paragraphs 5, 6 and 7 without prejudice to paragraph 8;

(iii) Member States shall protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status at the latest 15 years from the date of entry into force of this Directive, in accordance with the provisions laid down in Annex V, subject to the application of extensions determined in accordance with paragraph 4 and to the application of paragraphs 5, 6 and 7 without prejudice to paragraph 8;

(iv) Member States shall implement the necessary measures in accordance with Article 16(1) and (8), with the aim of progressively reducing pollution from priority substances and ceasing or phasing out emissions, discharges and losses of priority hazardous substances

without prejudice to the relevant international agreements referred to in Article 1 for the parties concerned;

Water Framework Directive

1.2. Normative definitions of ecological status classifications

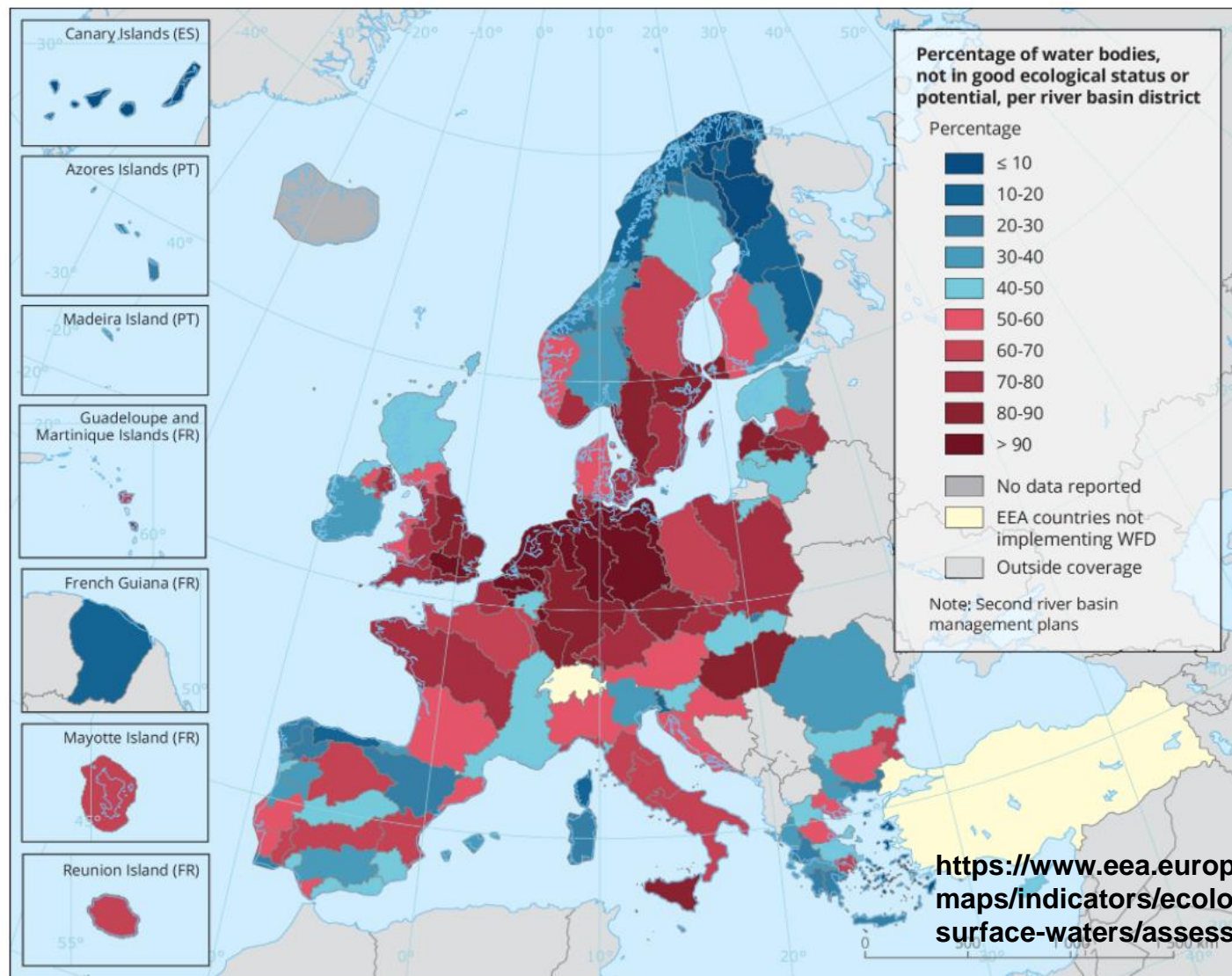
Table 1.2. General definition for rivers, lakes, transitional waters and coastal waters

The following text provides a general definition of ecological quality. For the purposes of classification the values for the quality elements of ecological status for each surface water category are those given in tables 1.2.1 to 1.2.4 below.

Element	High status	Good status	Moderate status
General	<p>There are no, or only very minor, anthropogenic alterations to the values of the physico-chemical and hydromorphological quality elements for the surface water body type from those normally associated with that type under undisturbed conditions.</p> <p>The values of the biological quality elements for the surface water body reflect those normally associated with that type under undisturbed conditions, and show no, or only very minor, evidence of distortion.</p> <p>These are the type-specific conditions and communities.</p>	<p>The values of the biological quality elements for the surface water body type show low levels of distortion resulting from human activity, but deviate only slightly from those normally associated with the surface water body type under undisturbed conditions.</p>	<p>The values of the biological quality elements for the surface water body type deviate moderately from those normally associated with the surface water body type under undisturbed conditions. The values show moderate signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status.</p>

Waters achieving a status below moderate shall be classified as poor or bad.

Fig. 2: Percentage of water bodies, not in good ecological status or potential, per river basic district



<https://www.eea.europa.eu/data-and-maps/indicators/ecological-status-of-surface-waters/assessment>

Other relevant directives

- **Dangerous Substances and its 'daughter' directives**
- **Nitrates Directive**
- **Freshwater Fisheries Directive**
- **Urban Waste Water Treatment Directive**
- **Directive on the Exchange of Information on the Quality of Surface Freshwaters**
- **Protection of Groundwater Directive**
- **Sewage Sludge Directive**
- **Floods Directive**
- **https://ec.europa.eu/environment/water/index_en.htm**

Urban Wastewater Treatment Directive

The Commission has now officially published the tentative agenda for forthcoming meetings of the College of Commissioners, and the revision of the Urban Waste Water Treatment Directive features on 26 October 2022 within a "Zero pollution package" containing also

- a revised list of surface water and groundwater pollutants
 - a revision of EU ambient air quality legislation and
 - a revision of the classification, labelling and packaging of chemicals (regulation)
- (publication SEC(2022)2428final of 6 September 2022).

UNDER REVISION

Infringement procedures

Legal basis – the European Union as a Union of Law

According to the Treaties (Treaty on European Union, Treaty on Functioning of the European Union), Member States are obliged to comply with EU legislation adopted by the legislator (European Parliament and Council), and the Commission has the right and the obligation to scrutinise such compliance and where appropriate take legal action.

Opening of an infringement procedure: formal contacts between the Commission and the Member State concerned

If the Commission considers that there may be an infringement of EU law which warrants the opening of an infringement procedure, it addresses a "letter of formal notice" to the Member State concerned, requesting it to submit its observations by a specified date.

The Member State has to adopt a position on the points of fact and of law on which the Commission bases its decision to open the infringement procedure.

Issuing a Reasoned Opinion

In the light of the reply or absence of a reply from the Member State concerned, the Commission may decide to address a "Reasoned Opinion" to the Member State,

Infringement procedures

clearly and definitively setting out the reasons why it considers there to have been an infringement of EU law and calling on the Member State to comply with EU law within a specified period (normally two months).

The purpose of those formal contacts is to determine whether there is indeed an infringement of EU law and, if so, to resolve the case at this stage without having to take it to the Court of Justice of the European Union.

In the light of the reply, the Commission may also decide not to proceed with the infringement procedure, for example where the Member State provides credible assurances as to its intention to amend its legislation or administrative practice.

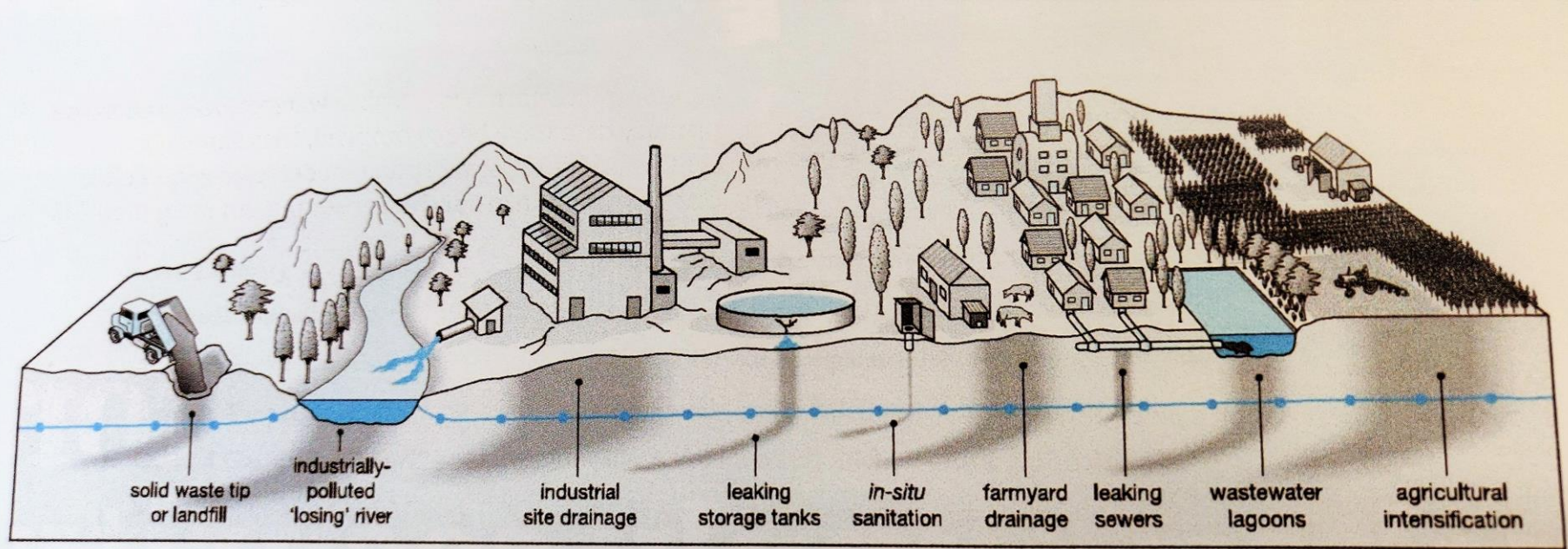
Referral to the Court of Justice of the European Union

If the Member State fails to comply with the Reasoned Opinion, the Commission may decide to bring the case before the Court of Justice of the European Union. If the Court finds in its judgment that a Member States has failed to take the measures needed to conform.

Second referral to the Court of Justice of the European Union

If a Member State fails to comply with a judgment given against it, the Commission has the possibility to apply for a second court ruling ordering that State to pay a lump-sum fine or a penalty (Article 260 TFEU).

Land-use activities commonly causing groundwater pollution hazard



From: Source – The Magazine of
International Water Association, July 2020

REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

on the implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based on Member State reports for the period 2016–2019

{SWD(2021) 1001 final}

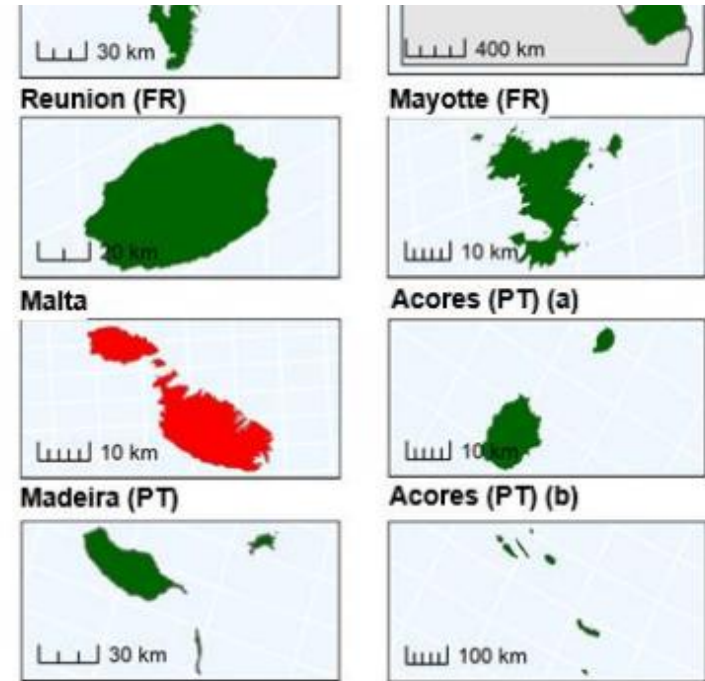
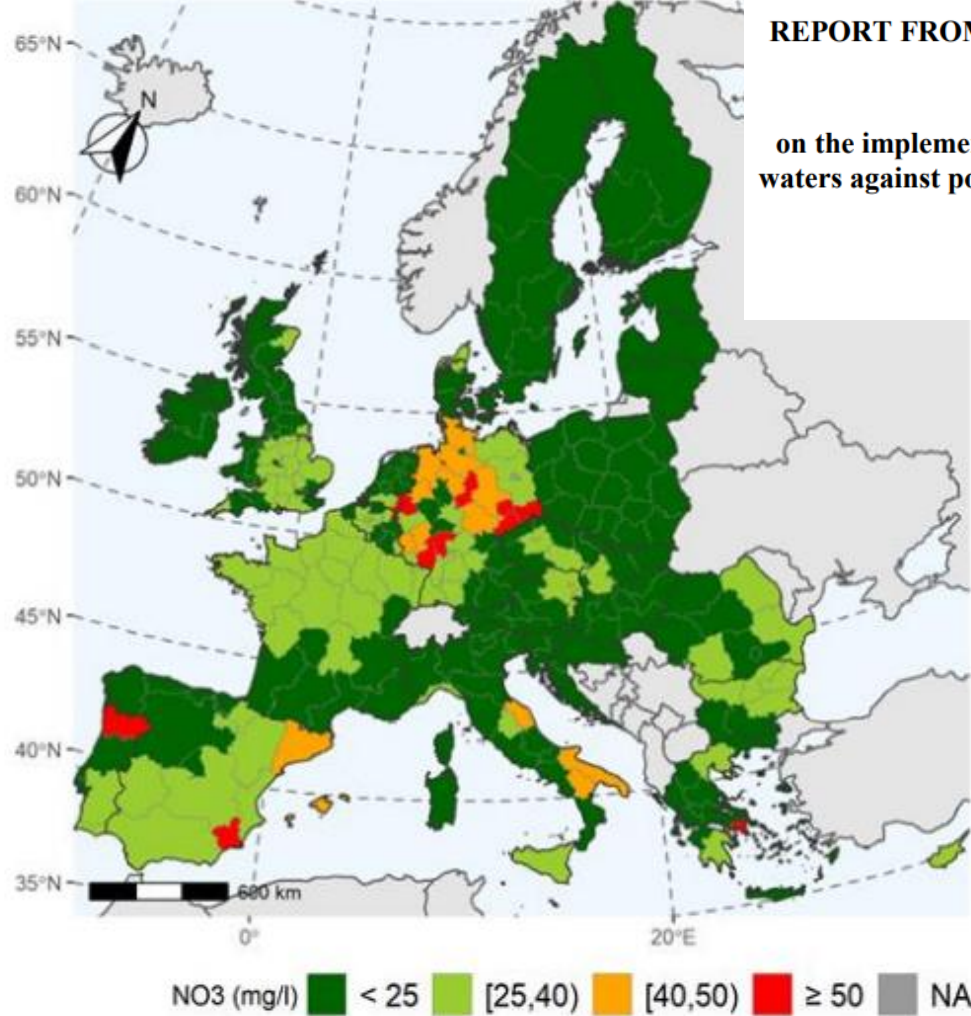


Figure 2: Annual average nitrate concentrations in groundwater at the NUTS2 level for the reporting period 2016-2019

Earth Syst. Sci. Data, 13,
1089–1105, 2021

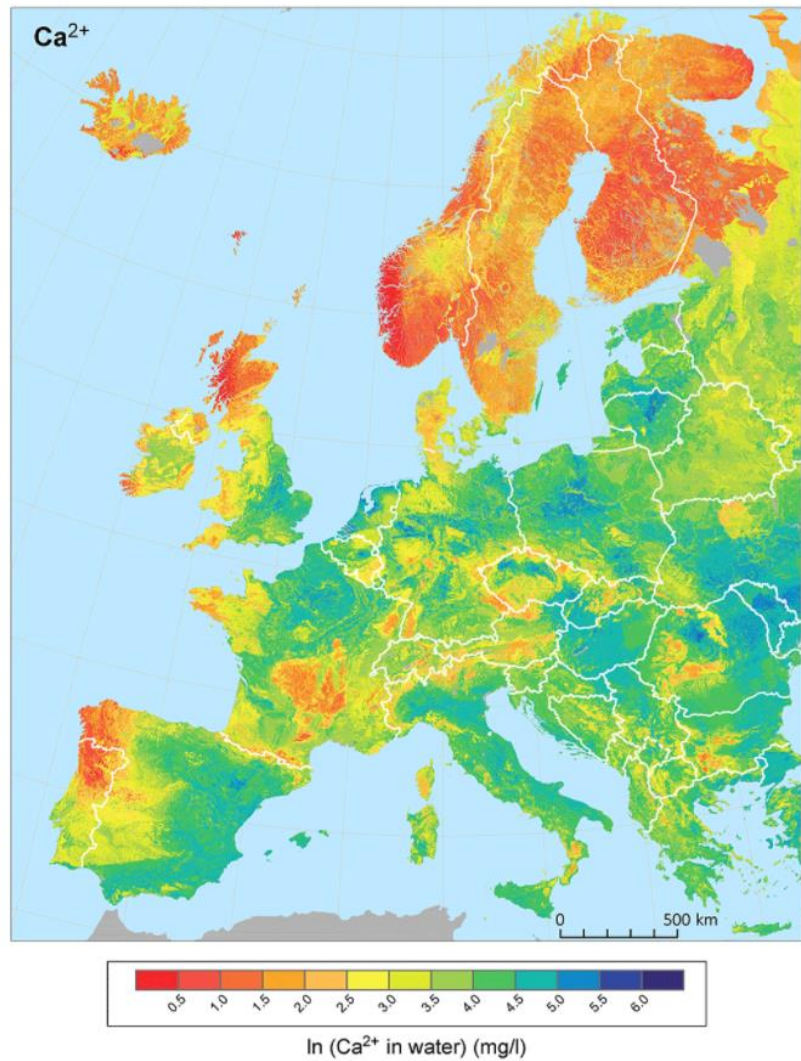
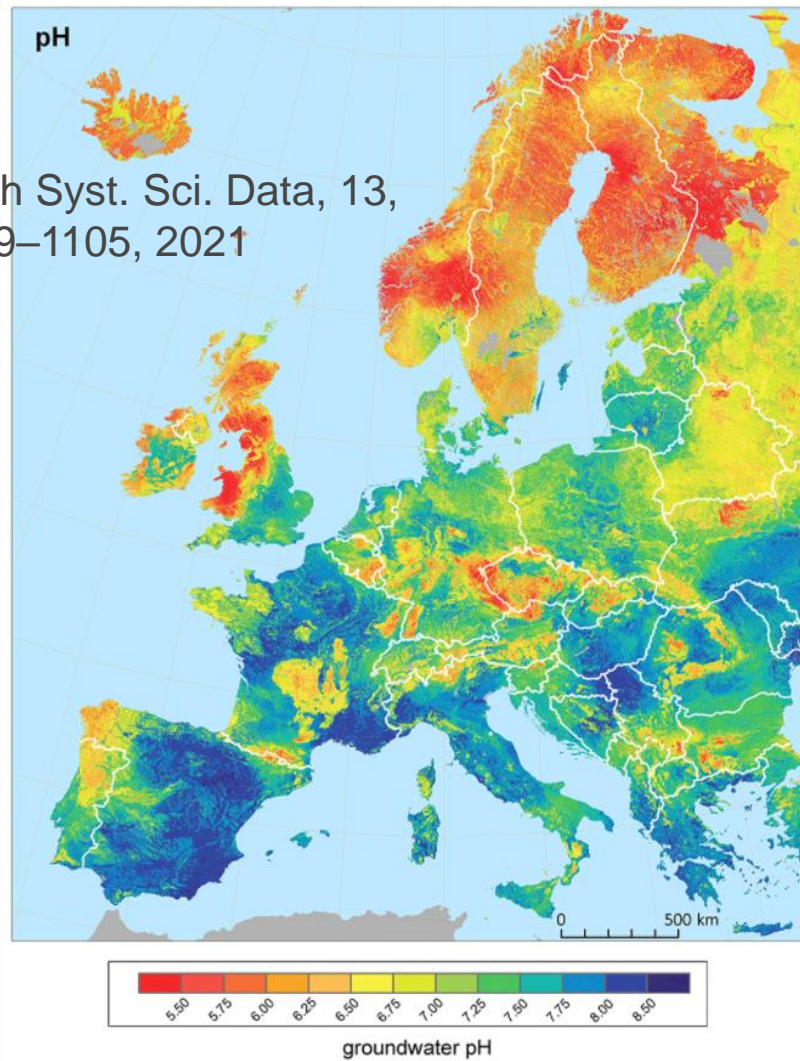


Figure 5 Model predictions based on regression kriging. Note that the Ca²⁺ concentration is on an ln scale. The map was created entirely by the authors with state borders from ArcGIS® version 10.2 (Esri, Redlands, CA, USA).

<https://www.eea.europa.eu/data-and-maps>

Mean annual Total ammonium /
Ammonium in rivers by country

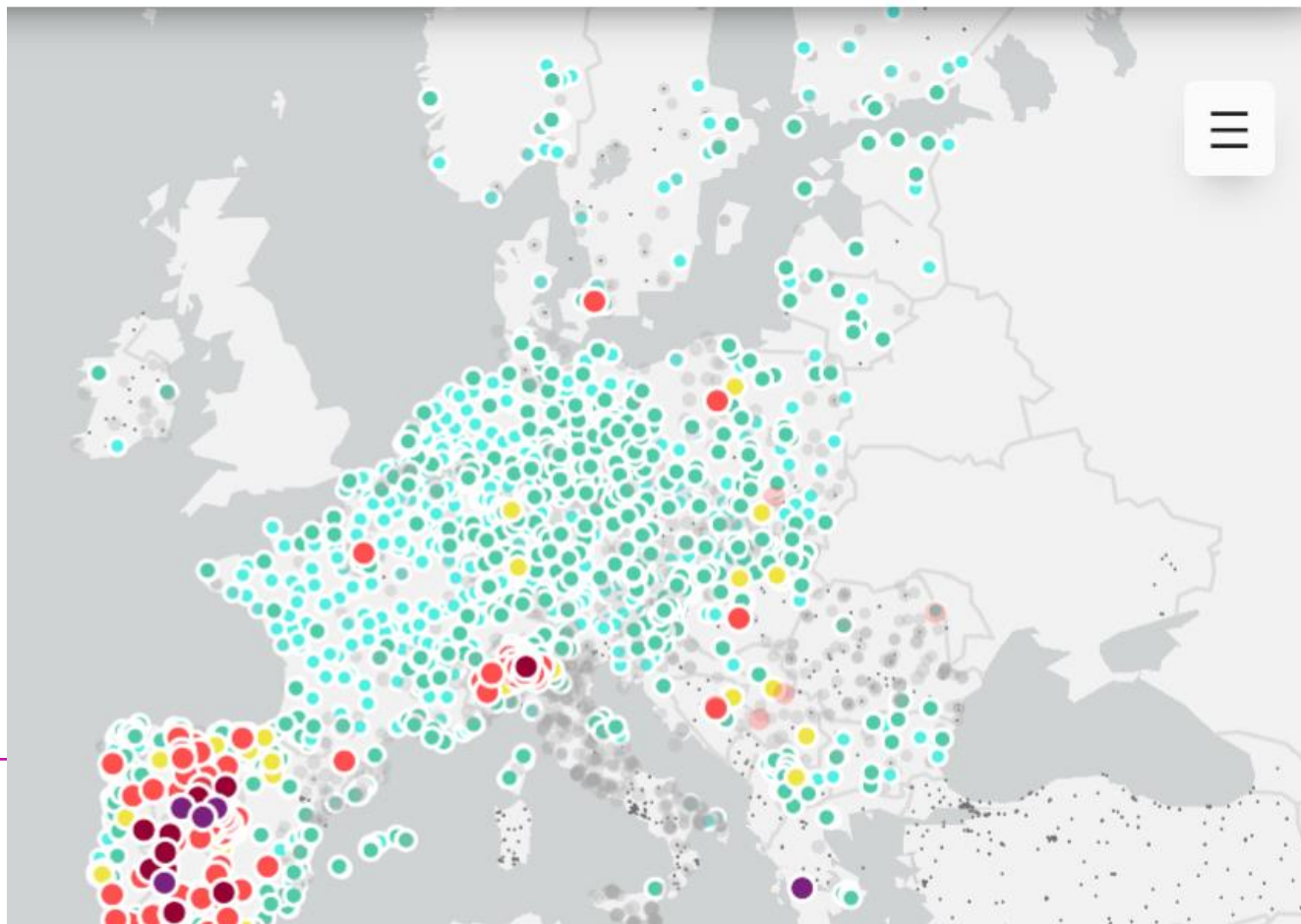
-
- The map illustrates the distribution of four main climate types across Europe. The pie charts are color-coded: blue for Type A (tropical), yellow for Type B (subtropical), red for Type C (temperate), and green for Type D (continental). The distribution shows a clear latitudinal pattern, with Type A dominating the southern regions (Mediterranean and parts of Western Europe), Type B in the south-central regions, Type C in the northern regions, and Type D in the far north (Russia and Scandinavia). Major cities and geographical features are labeled for context.

What about environment (soil, air etc.)?

Air quality

<http://airindex.eea.europa.eu/>

2022-10-06 11:00 UTC+3



Air quality

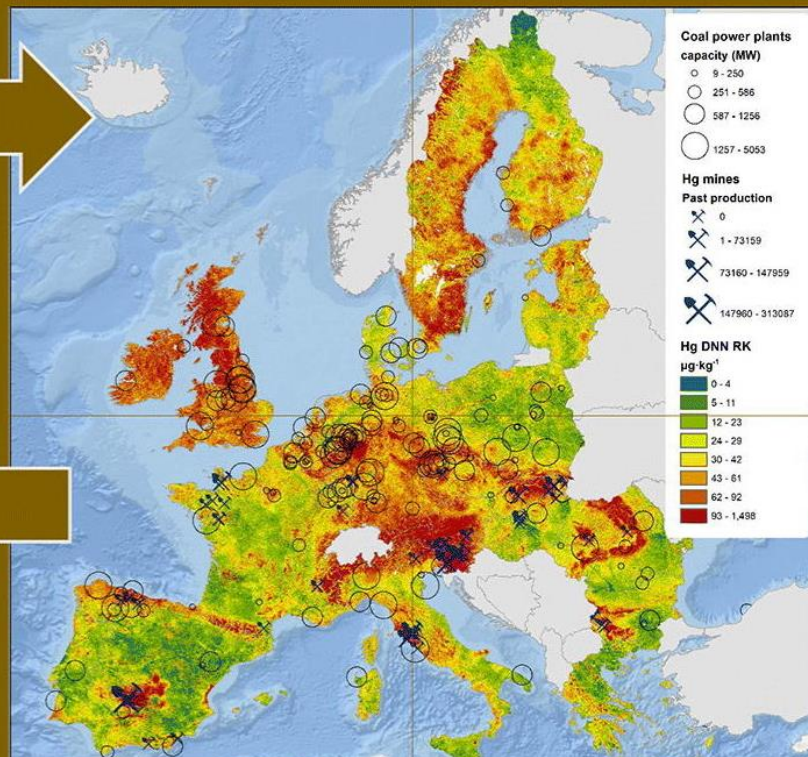
- Good
- Fair
- Moderate
- Poor
- Very poor
- No data

[Legend explained](#)

Soil quality

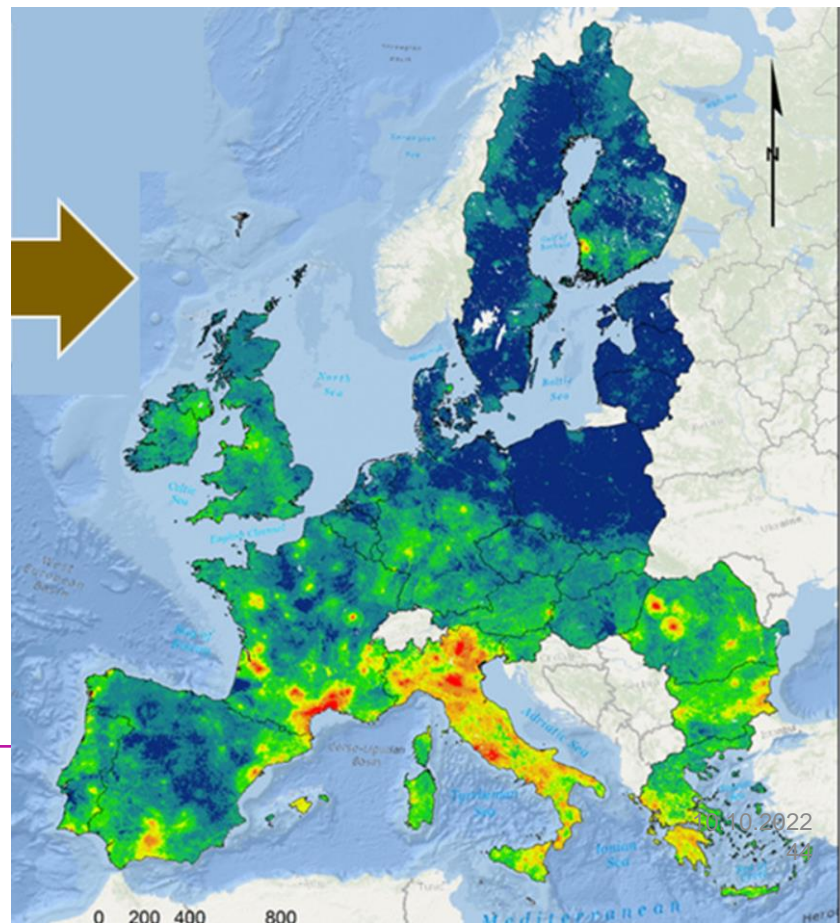
Science of The Total Environment
Volume 769, 15 May 2021, 144755

Map of soil Hg



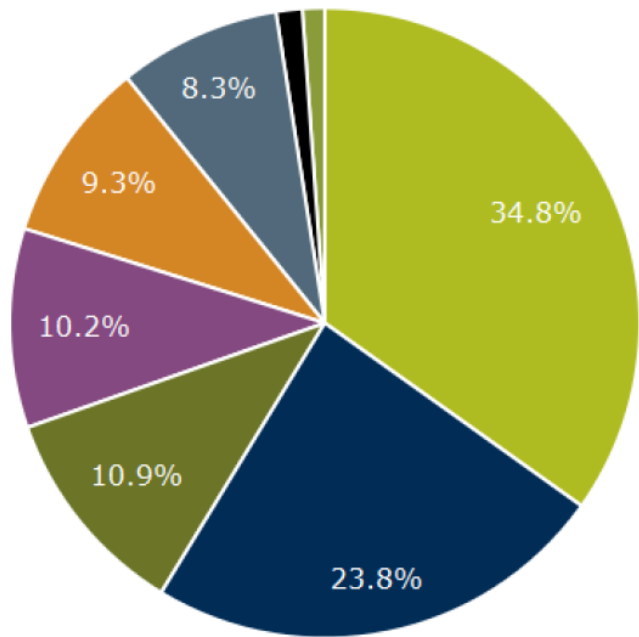
Copper (Ballabio et al., 2018)

Science of The Total Environment
Volume 636, 15 September 2018, Pages 282-298



Contaminants affecting the solid matrix (soil, sludge, sediment) (2011)

SYNTHESIS REPORT	GLOBAL MEGATRENDS	EUROPEAN BRIEFINGS	COUNTRY COMPARISONS	COUNTRIES & REGIONS
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- Heavy metals
- Mineral oil
- Polycyclic aromatic hydrocarbons
- Aromatic hydrocarbons
- Others
- Chlorinated hydrocarbons
- Phenols
- Cyanides

Data sources: JRC. Eionet NRC Soil data collection on contaminated sites; EEA – Indicator LSI003

Related content

Industrial
pollution to air,
soil and water

One example of environmental pollution

Dr. Antonina Kruglova
